Staff Paper

Adjusted Gross Revenue Pilot Insurance Program: Rating Procedure (Report prepared for the Risk Management Agency Board of Directors)

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An Overview of AGR Rating Procedures

The focus of this paper is on outlining the procedures used to estimate the premium rates for the Adjusted Gross Revenue (AGR) insurance plan. The AGR rating procedures draw substantially on rating procedures used in products currently reinsured and subsidized by Risk Management Agency/USDA (RMA); thus, the principal focus here is on those features that are a specific to AGR. The outline, briefly, the procedures used in rating existing products to set the stage for describing AGR rating procedures. The focus of AGR is on farms whose principal revenue streams are from NAP crops as contrasted to farms whose crops can be insured under a plan reinsured and subsidized by RMA; however, the procedures must recognize and take advantage of the fact that crops with APH plan insurance may also appear in the farm plans. Since the number of NAP crops is very large and since the information available differ substantially from crop to crop, the procedures draw on a wide range of information sources.

1.0 Background

The concepts used in rating AGR are the same as those used in the Revenue Assurance (RA) crop insurance policy developed by Iowa Farm Bureau. RA is available in 2001 for corn and soybeans in 15 states; it's also available for spring wheat, water wheat, sunflowers, feed barley, and canola in selected states. The analogy to RA procedures holds with respect to both the rating of individual crops and the rating of the combined revenue from multiple crops.

RA begins with estimates of individual crop yield and price variability and the market price-farm yield correlation to estimate premium rates for alternative coverages; they also permit the the option of insuring against shortfalls in the combined revenue from multiple crops (e.g. corn, soybeans, and wheat); that requires consideration of the correlation between each pair of revenue streams to estimate the premium rates. Thus, they must estimate the revenue premium rate, as contrasted to a yield insurance premium rate and a price insurance premium rate, for each of the crops insured under RA and have a method to account for all of the pair-wise revenue stream correlations to estimate the premium rate where insuring the aggregate revenue from multiple crops is permitted.

The RA developers began with a farm's APH yield and the premium rate to estimate the yield probability distributions. They imposed an assumption about the underlying form of the probability distribution and used the APH yield and rate information to form a specific probability distributions (i.e., specific parameters) that are crop/state/county specific. They inferred price probability distributions from the from the options premium in futures markets. The analogy to the APH insurance plan is the futures price is equivalent to the APH yield and the options premium is equivalent to the APH plan premium. The standard deviation of the price probability distribution is based on the assumption that price changes between pre-plant period and harvest could be approximated by a probability distribution widely used by futures and options market researchers and analysts. Market price-farm yield correlations were estimated using historical APH plan information.

The RA developers used the two probability distributions (price and yield) along with an estimate of the underlying correlation structure to numerically integrate out the required premium rate. They used Monte Carle simulation for integration; they simulate a large number of cases from the joint price-yield distribution and then performed a standard loss-cost estimation on the

simulated revenues to obtain the revenue premium rates for individual crops. These procedures generalize to the multiple crop case by simulating the combined revenue from all crops (given the share of each crop in the farm plan) and calculating the whole farm premium rate. Thus, they have a method for generating a whole farm premium rate given estimates of the yield and price variability for each crop and the requisite correlations.

They implemented their strategy, for practical rate quoting, by setting up an "experiment" with various APH insurance plan premium rates, APH yields, price volatilities, and correlations. For the multiple crop case, they also considered the crop shares in the farm plan. The process was simplified by making the correlations constant for regions (state, sub-state). Also, the range of price volatility is limited. They took the results and formed a regression equation to predict rate given APH yield and share mix. Those equations are used in the rate quoting software.

The same concepts were used in rating AGR; the differences lie in the information available on individual crops and on the between crop revenue stream correlation assumptions. The RA developers worked with crops/states/county's where a significant APH plan information base is available and, for the most part, where the crops are traded on commodity exchanges (e.g., CBOT). In contrast, the focus of AGR is on crops where the information base tends to be much less well developed and where the crops are not traded in exchange markets. In summary, AGR rating has implementation differences in two area. First, in most instances, more limited information for estimating individual crop rates. Second, even if all the relevant correlations needed for whole farm rating were available, there would be no practical way to implement the results in quoting software in the current IT environment. Thus, simplifications were required. This is reasonable since AGR is a niche product developed to deal with crops and farm types where the development of APH plan insurance has been very, very difficult. The focus is on NAP crops for which APH plan insurance is not available.

2.0 Acquiring Information Used in Estimating Individual Crop Revenue Premium Rate under AGR

The default procedure for the development of individual commodity AGR premium rates draws heavily on the elicitation of expert opinion to rank crops, ordinally, on a one to five scale with one having the lowest coefficient variation of variation (CV) in revenue and five having the highest CV. A sixth category was retained for commodities that were unusually risky. Crops with APH plan insurance coverage are included in the elicitation process. Thus, there is an objective way to calibrate rates by using existing APH plan loss experience information to estimate rates for other crops with comparable risk rankings. The APH plan premium rate information is converted to an AGR basis using procedures very similar to those currently used in RA; that is, the given an APH plan premium rate, calculate a revenue premium rate based on a price volatility adjustment factor and, if appropriate, a market price-farm yield correlation adjustment factor. In addition, other information will be brought to bear to the extent feasible.

The AGR rating protocol uses a variety of information sources to develop rates. These include: (1) elicitation of information from experts [principally, Cooperative Extension field staff (particularly, specialized agents); Farm Service Agency (FSA) county directors and state leadership, drawing on their farm knowledge and their claims experience under NAP and disaster programs; farm business consultants and lenders]; (2) secondary data, particularly county data, from NASS and supplemental state information where it exists (e.g. Oregon); and (3) long-term

series of individual farm record data where they exist [e.g. Michigan's TelFarm project; Cornell University's Farm Business Analysis farm record project; projects runby adult Vocational Education instructors (e.g. Oregon)]. The final task is to integrate the information from these diverse sources to arrive at premium rates required for each crop on the crop list.

2.1 Focus Groups: Elicitation of Relative Risks Across Crops by Experts

2.1.1 Extension, Farm Management Consultants, Lenders, Risk Ranking

This section will describe the steps used in the elicitation process. The process has two objectives: (1) obtain a complete list of the crops grown in the area and, where critical, include more defining information (e.g. irrigated vs. dry land vs. irrigated as needed; marketing fresh vs. marketing processed; muck vs. mineral soils) and (2) placing each crop in a risk "pool" where all of the crops in a single pool have similar revenue risk (CV of gross revenue) if. Typically, and five pools are used plus a pool for very unusual risks.

The discussion that follows is broken into elicitation of information from ES, farm management consultants, and lenders vs. FSA. The two groups have much in common but also differ significantly in how they interact with growers and their information bases; FSA eperiences draws heavily on disaster and NAP payment experience for yield shortfalls. The discussionstarts with the former group since that is the group that the AGR rating team typically meets first.

Elicitation of ES, farm management consultants, lenders

Step 1: Crop List

Send a preliminary crop list to experts prior to "face-to-face" meeting or teleconference as a beginning point for discussion. The experts may add crops, delete crops, or modify definitions on this list as they proceed through the discussion. There will be substantial interaction and double-checking by experts with each other. The elicitation typically is done in with the experts present but RMA has also had good experience in a teleconference setting, providing some members of the RA rating team have basic knowledge of the area.

Step 2: Place Each Crop in a Risk Pool

This section describes the process used to get at relative rankings, stressing the point with the participants that in the "first pass" the AGR rating team is not worried about getting absolute levels of the coefficients of variation but simply getting crops ranked relative to one another from a revenue risk perspective. For ES groups who have experience with managing experiments and reading technical articles, it is useful to ask the participants to think in terms of the CV of revenue of an enterprise budget. In the process of ranking crops, experts are asked to describe the principal reasons for revenue shortfall and a measure of the frequency and severity of shortfalls. There typically has to think in terms of experience over the last 15 years but also taking account of structural changes that are currently taking place.

Begin by asking the participants to describe one or two crops which would be in the lowest revenue risk pool (pool 1) and in the highest revenue risk pool (pool 5)–as a starting point. This facilitates two things. Usually, people find it relatively easy to pick the least and most risky crops and it initiates the discussion.Also, asking why those ranks occur focusing on the nature of both production risk and price risk sharpens the discussion.

Price risk can be particularly difficult since people think in terms of quality issues that influence price, on one hand, and within season vs. between season price risk. The focus here is

on between season price risk, but the season average price variability from year to year may be highly influenced by timing issues, particularly for early vegetables, in terms of success at hitting target markets. Technically, the best way to think about quality is to use the APH plan concept of quality-adjusted yield so that one is not confusing variation in the price the individual receives due to quality vs. price variation that's common to all their peers in a market.

When complete, e-mail notes back to conference participants with both the ranking groups and with the comments for their double-checking and clarification of any questions that you may have as you work through your notes. You may also want to ask for some supplementary information such as indirect ways at trying to get at the correlation between individual farm yields and the market price they receive. In most work, the assumption is there is no relationship; but for some crops (e.g. tart cherries in Michigan) there is a significant negative correlation between farmer yield and market price received that moderates revenue variability as contrasted to price variability.

2.1.2 FSA CED's Risk Ranking

Step 1: Developing a Crop List

As in the case of the ES specialists, farm management consultants, and lenders, ask the group to review the crop list. They have the most extensive experience in making payments either under NAP or disaster aid in and they've had to have crop lists they've generated for those purposes. Your crop list may be more highly aggregated (less detailed) than they have used, but that's the beginning point of the discussion. Also, during this discussion the CED's often comment on farmers that they routinely see come in vs. those farmers who only come in when there is a unusually bad, generally systemic catastrophic event (e.g. catastrophic drought; catastrophic excess moisture). Our focus here is on the better manager risk pool. But, note in your working notes their comments on the incidents and problems with farmers who routinely make claims vs. the "commercial" risk.

Step 2: Placing Crops in Risk Pools and

The process here is generally similar to the one followed by the ES field staff specialists. However, typically focus t on yield risk, with occasional discussions of revenue risk. The rationale is that most of their experience is in paying claims is with respect to yield, not revenue risk.

In this discussion, make sure that they focus on relative frequency of claims in the sense that a large crop may have lots of claims but the relative frequency may actually be smaller than a crop with less acreage. Our focus is not on the aggregate risk, but on the risk generated in a typical acre; this point has to be stressed occasionally. Generally, during these discussions FSA CED's draw on their claims experience in very direct and thoughtful ways. This is typically good quality discussion.

3.0 Primary and Secondary Data Sources and Methods of Analysis

This section describes primary and secondary data sources that are used in the rate estimation process. As noted previously, these very substantially from state to state and generally are limited, particularly on a county basis, for NAPcrops. The second section describes the

method of analysis to obtain information on yield, price, and revenue CV's to support the estimation of premium rates.

3.1 Sources

3.1.1 NASS / State supplements to NASS (Oregon)

NASS information in most states is available at a county level on USDA program crops such as corn and on the other crops that are grown in a large number of counties and in quantity. Sugar beets and potatoes would be examples in states with significant acreage of these crops. In contrast, information on NAP crops is seldom available at county level and for minor net crops is also not available at the state level. Oregon is an exception because supplementary state funds are used to provide county level information on yields and prices for over 100 crops, most of which are NAP crops

3.1.2 Farm Record Projects

Some states have farm record projects which maintain coordinated financial statement information on individual farms, including the accrual income statements used in AGR. Typically, but not always, these projects include information on the acreage of each crop and yield. These projects are typically within a land grant University, Farm Credit Services, Farm Bureau, adult vocational agriculture, or some partnership amongst these groups. These projects tend to have larger databases for the major agricultural commodities; thus, to the extent that the crops targeted by AGR are a major crop in the state, they will appear in the database.

The farmer record project information is useful in two ways. First, it provides information on the historical volatility of revenue by crop as well as aggregate farm revenue at the level of detail used in the AGR insurance plan. Second, the information is useful in extending the applicable at the of county, and to a lesser extent, state NASS information because of the relationship between farm CV's and NASS CV 's can be used to calibrate the NASS information for more direct application in rating. This calibration procedure is also use in the development of new APH plan products as he is the analogy process that underlies the RMA risk pooling and calibration procedures.

3.2 Method of Analysis

The method of analysis for calculating CV's is very similar across prices, yields, and revenues and for alternative levels of aggregation ranging from farm to state. First, the time series data are plotted to see if transit says or if there are unusual patterns were apparent errors in the data. Second, if there are trends, the data are statistically de-trended. Third, CV is our calculated by dividing the standard deviation of the deviations about trend (with an adjustment for within sample estimation) by the average for the period. This approach along with ancillary information is used to obtain the CV's for price variation for crops for which the APH plan is available to convert the APH plan premium rates to AGR premium rates.

4.0 Synthesis

The first step in the synthesis is to use the information from elicitation and, where available, from primary and secondary sources to check the consistency of the ordinal ranking of revenue relative risk's/CV's. If there are discrepancies, the AGR rating team revisits both the primary and secondary data sources and the experts notes. Second, where there is adequate information from primary data sources, information about the relationship between primary source CV's and APH plan premium rate information, and secondary data absolute levels of premium rates are estimated for consideration. Information about the relationship between primary source CV's and APH plan premium rate information is needed because the observed premium rates always exceed the average risk implicit in farm record data. In the absence of this information, the more typical case, the AGR rating group proceeds directly to the calibration of rate for each of the rate groups using APH plan information. If no meaningful APH plan information is available, the AGR rating group reviews rates for areas as nearly comparable as possible. Also, comparisons are made both with respect to ordinal ranking and to the absolute level of rates for areas that are generally similar.

5.0 Coverage Rate Relativities, Adjustment of APH Plan and Basic Unit Rate Information to Whole Farm Rate Information, and Calculation of Diversification Discounts

The calculation of the whole farm AGR premium rate is done in two steps. First, a weighted average rate is calculated for the whole farm. The weights are the share of each crop in expected revenue; they are revenue share weights. The rates used for each commodity are based on what they commodity rate would be if that were the only commodity grown on the farm. Second, a diversification discount is calculated and the whole farm rate is discounted for their degree of diversification diversification. The sources of diversification considered include the number of crops, up to six, and the degree of diversification across crops. For example, a farm with 90 percent of its revenue coming from one crop and five percent from each of two other crops is not very diversified even though there are three crops. Six crops was used to set the maximum diversification discount allowed. In the underlying modeling, using procedures similar to those used in the RMA insurance plan rate setting, the appropriate discount falls further increases in the number of crops but a substantial share of the reductions are accrue with six crops. The estimate, based on limited data and scenario modeling, of the average pairwise correlation between revenue streams on diversified NAP crop farms was 0.3. Under that estimate, the maximum discount factor would be 0.3 for a very highly diversified farm. The maximum discount factor permitted under AGR is 0.41. Rates based on these procedures were tested against the whole farm data on about 50 farms for five years in each of the original pilot areas and found to be sufficient with a significant safety factor; but, it is recognized this is a very small sample and indemnities paid frequently exceed exante estimates. A

5.1 Coverage Rate Relativities

The coverage rate relativities used in AGR are the same as used in most of the APH plan crops. This is the relationship between rates for alternative coverage levels. The simulation modeling to estimate the premium adjustment factors for price volatility are based on underlying probability distributions that generate the same coverage rate relativities has our used in APH plan

rating. Thus, the structure of the premium rate data files is essentially the same as in the APH plan; there is a base AGR premium rate with rate relativities to generate the rates and alternative coverages.

5.2 Adjustment of APH Plan Basic Unit Rate of Information to Whole Farm Rate Information

APH rates in the absence of base and optional units are typically significantly lower. This occurs for two reasons: (1) spatial diversification which is typical in most farms means the revenue variability when all units are combined is less than the variability on individual basic or optional units and (2) the opportunity to manipulate unit yields to generate indemnity payments to substantially reduced. There is little hard data for most NAP crops to definitively estimate what the adjustment factor should be when rates are based on all the acreage on the farm being included vs. when basic and optional units are available. There is considerable anecdotal evidence that a discount is appropriate and studies have been conducted for a limited number of APH plan crops and on Illinois information for corn soybean farms. Also, some small studies have been conducted comparing rates implied by whole fruit farm information and APH plan rates.

Enterprise discounts as high as 35 percent are currently available for some insurance products; that is, discounts based on insuring all of the acreage grown in the county as a single entity as contrasted to insuring basic or optional units. A discount factor of 35 percent is typically use for AGR based upon the synthesis of the variety of studies that are available and discounts currently available under existing products. The largest discount factor considered it is 40 percent, very seldom used, and the smallest discount factor used it is 20 percent.

5.3 Calculation of Diversification Discounts

The procedure for the calculation of diversification discounts uses the same general principles as underlie the RA insurance plan but the implementation is quite different given, as noted in the introduction, the information available on each crop and the scope of the number of commodities that must be taken into account.

In principle, the diversification discount should depend on both the share of each crop in the farm plan, the correlation between the revenue streams of each pair of crops, and the premium rate. These are the same principles used in the calculation of the expected variability of financial portfolios. For AGR insurance plan rating, as contrasted to RA insurance plan rating which accurately accounts for each source of variation, the assumption was made that the maximum discount occurs when an equal proportion of each commodity is in the farm plan. This assumption is strictly true only if all commodities have the same rate; thus, sensitivity analysis was carried out to estimate the potential seriousness of the bias and to estimate the safety factor to protect against the simplification.

Statistically estimated equations were developed based upon the number of crops in the farm plan; that is, there are separate equations for each member of crops in the plan up to six crops. The maximum diversification discount increases as the number of crops in the plan increases. To estimate the equations, experimental designs were set up where the factors varying where the share of each crop in the farm plan. The whole farm premium rate was estimated for each experimental observation. Procedures to this point are quite similar to those under the RA

rating plan except for the assumptions of similar rate across products and constant correlation. That is, the approach is the same but there are differences in the parameters used.

A relatively simple index of diversification was created by examining the absolute difference in the share of each commodity from having an equal amount of each commodity in the farm plan. That is, the index is zero if there is an equal share of each commodity in the farm plan. On the other hand, if a single crop dominates, there will be a large deviation for that crop. The index is based on summing up the deviations for each of the crops. The equations are based upon predicting the appropriate whole farm rate has a percentage of the weighted average vs. the index. They approach is very simple but is a good approximation under the estimate of a common 0.3 correlation.

5.4 Implementaion of the rating procedure

Implementation requires for sources of information: (1) AGR rate file, which is the same structure as an APH rate file; (2) the share of each commodity in expected whole farm revenue; (3) number of commodities in the farm plan (see procedures for the definition of commodity) and (4) the equation for calculating the diversification discount factor given the number of crops in the farm plan.

6.0 Rate Review

Rate review for the AGR insurance plan differs in the significant ways from both rate review procedures for the APH insurance plan and for the revenue insurance plan procedures. There are three general questions which must be evaluated as insurance as experience accumulated. First, is their evidence that particular crops or classes of crops are misclassified; are they and the right rate pool? Second, is the general level of rates sufficient for the rating area. Third, are their policy design features that have not been adequately taken into account (positive or negative) in the current rating procedures. These have largely to do with the procedures used as a basis for the revenue guarantee, adjustments in the revenue guarantee, and in the farm plan.